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LEAN IN EDESA

Final Thesis
written in IFE
under the supervision of
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AKNOWLEDGEMENT

It has not been an easy task, but I would like to thank Eduard Barragan, from Edesa Horeca, to help me showing me the plant and providing me information about the company. I would also like to thank Jan Krolikowski his efforts to follow me and help me during the process.

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1 INTRODUCTION

1.1. Background

This thesis is about Lean Manufacturing. Lean Manufacturing comes from the Toyota Production System created by Kiichiro Toyoda and Taiichi Ohno from Toyota, in 1940s, based in just in time methodology.

Lean method has reached considerable popularity in the latest world. Countries such as Spain or Poland are clear examples of it, because it can be noticed that more and more companies are adopting Lean methodology there.

1.2. Literature review

This thesis is divided in two parts. The first one is about Lean and how to implement Lean in terms of theory. The second one is about a real case, Edesa Horeca, which belongs to a spanish group but has its production plant in Poland.

Both parts are structured in the same way. Following the steps necessary for Lean implementation, it can be seen the theory in the first part and the reflex of this theory in a real example, in the second part.

1.3. Aim of the thesis

The aim of this thesis was, based on the theory, check if Edesa Horeca was using Lean system, how it was using it and how could Lean techniques improve its work.

1.4. Research method

To achieve this objective, it has been research about Lean method theory. Where it comes from, which are the Lean tools that can be used, how to implement Lean and which are the benefits that can be achieved using it.

After acquired this knowledge, it has been made an observation of Edesa Horeca working, making a visit at the company in Warsaw. Finally, it has been interviewed few times the general director of Edesa Horeca, Eduard Barragan, to know more about their way of working and Lean use.

LEAN

2 Introducction about lean system

2.1. Envoirement and competitiveness[1]

It has reached a situation where competition has increased, global competitors have appeared and there is not only a huge diversity of clients, but also a big variety of substitute products. The market has turned from 'sellers market' to 'buyers market', where the value of the products is settled by the clients request.

Nowadays, competitiveness demands companies to guarantee quality in their products, productivity, low expenses, flexibility, quick response and a big variety of products and services. While in the traditional manufacturing model there were high production volumes, big lots, a lot of stock and inspections just at the end of the process, Lean has achieved to adjust these to the current market demand.

2.2. Origin of Lean[2]

In 1910s Henry Ford created a production process where interchangeable pieces were added to the product, which was running on an assembly line, following a standard method of work. It was a big step for the homemade production, where products were made by one single qualified worker. With this new method, it was possible to increase significantly the productivity, but it became difficult to get variety in the products.

After World War II, Kiichiro Toyoda and Taiichi Ohno from Toyota rechecked Henry Ford's system and, adding some improvement, they got a continuous flux of the process and solved the problem of the “non variety” production. The system they developed was known as TPS (Toyota Production System). TPS began to be known worldwide since 1970s and specially on 1980s.

1

Source: CUATRECASAS, Lluís. *Claves de Lean Management: Un enfoque para la alta competitividad en un mundo globalizado.* Barcelona: Ediciones Gestión 2000, 2006. ISBN-13: 978-84-96612-13-6

2 Source: MAS, Xavier. *Introducció al Lean Management*. Barcelona: VILAR RIBA, 2011.

Fig.1 Former Executive Vice President in Toyota, Taiichi Ohno.

In 1990 it appeared for the first time the term “Lean Manufacturing” in a book named “The Machine That Changed the World” by James P. Womack and Daniel T. Jones. Since 2000, Lean spread from manufacturing field to all kinds of producing industries and even to management of enterprises from other sectors, appearing the concept 'Lean Management'.

2.3. Philosophy and Lean principles[3]

The philosophy of lean basically consists on constantly check and removing anything that does not add value to the product (waste)[4]. This is helpful to get a fluid flow in the process and being able to be flexible in front of the changes that customers demand. The goal is to give the client the product or service he/she has required (quality and quantity), as fast as possible and using the minimum of resources.

3 Source: WOMACK, James P.; JONES, Daniel T. *Lean Thinking*. Barcelona: Ediciones Gestión 2000, 2005. ISBN: 84-8088-689-7

4 Appendix 1

The principles of Lean are:

- The value is defined by the client request
- Remove anything that does not add value
- Create a soft and fluid flow through the process
- Clients pulls the product when they need it
- Continuous improving (Kaizen)
- Produce only what is needed, when needed and in the amount necessary (JIT)
- Minimize the total time of the process
- Produce with quality
- Optimal use of the equipment

Lean organization has to focus its efforts on teamwork, training of its workers, flexibility, optimization and standardizing processes, remove waste, leverage resources to create value and always watch what the client wants.

2.4. Scope of application[5]

Lean concept was created to improve issues in automotive sector, in 1990. A decade later, it spared to other fields. Lean methodology, as known as Lean Management, can be applied nowadays in many scopes. The most significant scopes are:

Lean Manufacturing: oriented in the industrial sector.

Lean Services: oriented on the services sector.

Lean Office: oriented on the administrative sector.

5 Source: MAS, Xavier. *Introducció al Lean Management*. Barcelona: VILAR RIBA, 2011.

3 Implementation of lean

3.1. 5S's[6]

5S is a technique designed to improve and maintain the organization, order and cleanliness in the workplace. The 5S's are the bases of the organization and visual control of the workplace.

This technique achieves saving time on tools and materials research, improves the quality of products, processes and services, increases equipment availability, increases productivity and improves working environment. It also increases job security, helps acquiring better habits, increases motivation, communication, commitment and encouragement of employees, evidences abnormalities, prevents errors and releases misused areas.

The term "5S" comes from 5 Japanese words that begin with the letter "S":

Seiri (Tidiness)
Seiton (Orderliness)
Seiso (Cleanliness)
Seiketsu (Standardization)
Shitsuke (Discipline)

Once the 5S process applied, the workplace should be a place where unnecessary materials and supplies have been deleted, everything is sorted and identified. The work place is clean and dirt has been removed from everywhere. There are visual controls to detect and correct anomalies. The above points are applied and continuously improved.

6 Source: MAS, Xavier. *Introducció al Lean Management*. Barcelona: VILAR RIBA, 2011.

1. Seiri (Tidiness)

It consists on identifying, classifying and sorting out the things that are really necessary for those which are not necessary to have them in the workplace. Those unnecessary things must been thrown away the workplace.

Steps:
- Make a list of all the things that exist in the workplace
- Sort the items according to frequency of use and need
- Locate things by frequency of use and throw away unnecessary
- Prepare a list of new articles detailing the frequency of use and location
- Review what was unnecessary and analyze the source of the problem

2. Seiton (Orderliness)

Locate the materials needed in the process with the purpose of making it easy and fast to find, use and replenish them. Each item must be clearly identified and in its place, which must be unique for. Everyone must know where to find the necessary material for their task and the access to this must be comfortable and fast.

Steps:
- Create a location for each item: Where?, How?, How many?
- Sort things in a simple and functional way
- Define and paint areas
- Identification of locations

Fig. 2 Example of Seiton

3. Seiso (Cleanliness)

It consists of thoroughly cleaning the workplace, eliminating dirt sources and establishing a procedure to keep the space clean. The aim of this is to work in a clean and in good place conditions, have the equipment in good conditions, increase workplace safety and standardize the cleaning procedure.

Steps:

- Do a thorough cleaning of the workplace and its environment, including machines and tools.
- Locate difficult areas to clean and give solution
- Identify sources of dirt and remove them
- Verify that the equipment works properly
- Establish and standardize a procedure for cleaning: What?, Who?, How?
- Do not mess. It is the best way to keep something clean

4. Seiketsu (Standardization)

It is about standardize and implement visual controls to manage the order and cleanliness. Keep the workplace under optimal conditions, having standardized workplaces and quickly identifying and correcting any anomalies.

Steps:

- Designing systems and procedures to ensure the maintenance of the workplace in good condition
- Standardize and document jobs
- Set as acting to correct abnormal situations
- Create standards and put them in the workplace
- Implement visual controls

5. Shitsuke (Discipline)

Working according to the established rules to maintain and improve the organization, order and cleanliness of the workplace. It helps to create the habit through established procedures and these maintains and continuously improves the workplace environment.

Steps:

- Implement a system of regular assessments to identify deviations and opportunities for improvement
- Perform an education campaign on the use of standards and procedures
- Continuous training

3.2. Heijunka

3.2.1. VSM[7]

Value Stream Mapping (VSM) is a representation of the process. On it are illustrated materials and information state along the procedure, from the customer's need to be delivered as finished product. In VSM there are both, value-adding activities as non-value adding activities, necessary to produce the product.

VSM works on the overall vision of the activity, not on the individual processes. It leads to the optimization of the overall, it identifies waste and its causes, it also helps to understand the process flow and provides a standard language to talk about the process.

There are some steps to implement a VSM. First of all, draw the current VSM. After that, propose solutions and prioritize improvement activities. Finally, design the future state.

Current VSM

To develop the Current VSM is necessary to carry out the following points:

1. Select a product family: define product family and make a list of them with their description.

2. Create a working team: select people from different areas, become familiar with the product and trained in the use of VSM. Designate a team leader.

7 Source1: MAS, Xavier. *Introducció al Lean Management*. Barcelona: VILAR RIBA, 2011. Source2: http://todaysleanmanufacturing.com/future-state-map/

3. Understanding customer demand: Gather information on customer demand (number of clients, demand for each product, packaging, days and shifts, etc.).

4. Draw the process flow map: draw processes using boxes (each box is a process where material flows inside) and collect the necessary information for each process (cycle time, preparation time change, OEE[8], number operators, shifts, packaging, waste, etc.).

5. Draw the map of the material flow: draw stocks (using a triangle to indicate the location and quantity) and draw receptions and expeditions (using the icon of a truck and a broad arrow). Indicate relevant information as frequency, packaging, etc..

6. Draw the map of the flow of information: draw the departments involved in the information flow and represent the flow of information indicating the frequency and type of transmission.

7. Calculate Lead Time: draw a timeline showing stock under each process and stock. Calculate Lead Time summing the processing time and waiting time.

8 Overall equipment effectiveness (OEE) is a hierarchy of metrics developed by Seiichi Nakajima in the 1960s to evaluate how effectively a manufacturing operation is utilized.

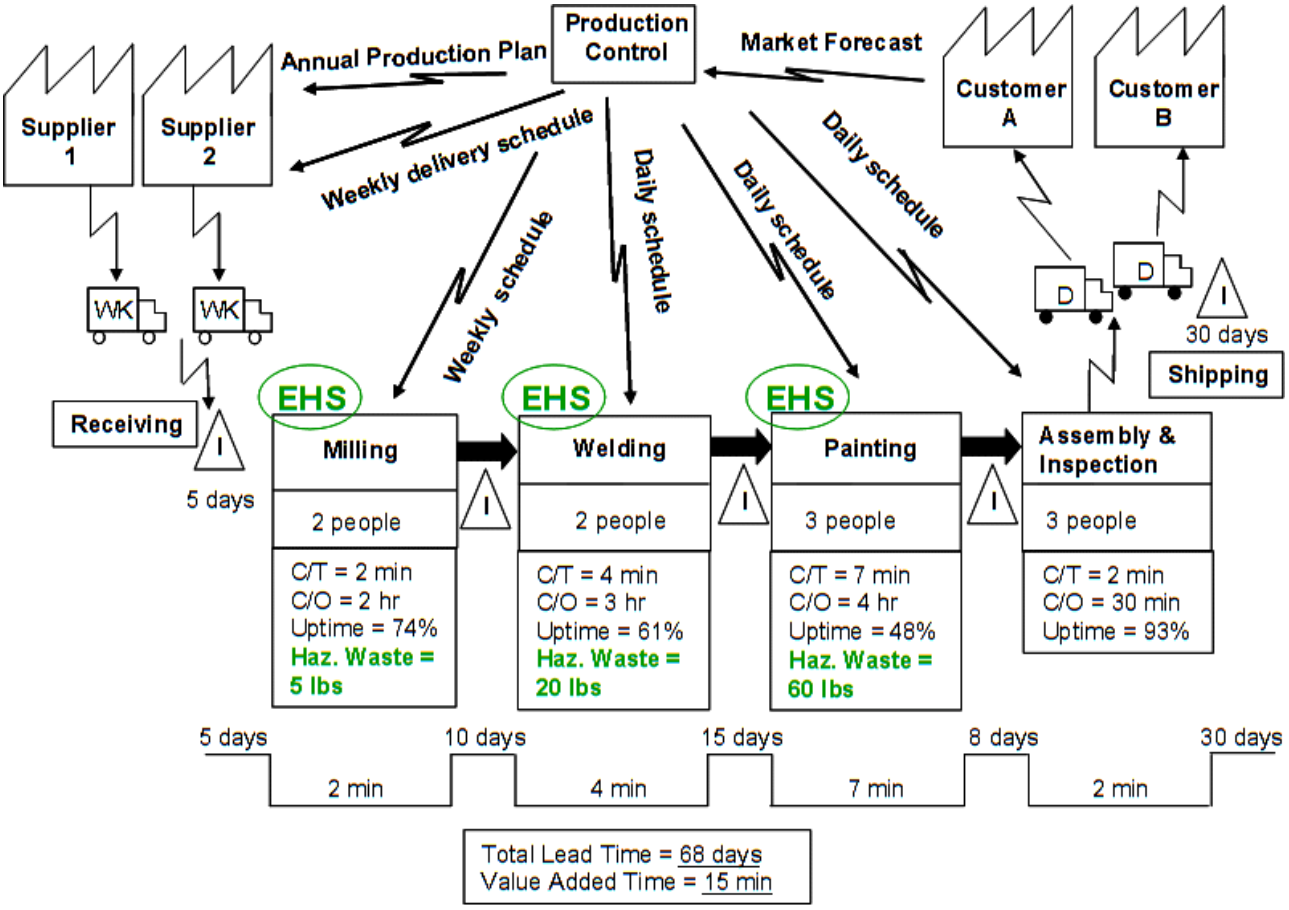

Fig. 3 Current state map.

Future state

To develop the future state map is advisable to answer some of the following questions, draw ideas from future map directly on the current state map:

- What is the Takt Time[9]?
- It should be built to a finished goods supermarket or directly to shipping?
- Where continuous flow can be introduced?
- Where will require supermarkets and pull systems to control production processes above?
- What single point in the production chain (the pacemaker process) should be scheduled?
- How the production mix at the pacemaker process[10] should be leveled?

9 Takt Time is calculated by the available production time divided by customers demand.

10 Pacemaker process: Any process along a value stream that sets the pace for the entire stream. (The pacemaker process should not be confused with a bottleneck process which necessarily constrains

- What consistent increment of work should be released and take away at the pacemaker process?
- What process improvements will be necessary for our future-state value stream to flow as designed?

3.2.2. Flow: layout[11]

Often, factory machines are placed in a way that it is difficult to understand, at first sight, which is the flow of materials. One reason to explain why some operations in the process are carried out far from the next operation may be that, as factories grow, new jobs are created where space is available. Another explanation for this distribution is that there are people who believe that similar types of machines and operations must be controlled by a single supervisor in a single area.

Process Layout

This layout, which has been referred above, may be logical from the point of view of supervising, because certain operations are controlled by a single supervisor. On the other hand, it can be noticed that it causes certain problems that worsen the global economy of production:

1. Difficulty of coordination and production scheduling
2. Waste in transportation
3. Accumulation of stocks in the process
4. Double or triple handling of materials
5. Extremely long time manufacturing
6. Difficulty in identifying the cause of defects
7. The flow of materials and labor of the operators is difficult to standardize
8. Improving difficulties due to lack of standardization

downstream processes due to a lack of capacity.) The pacemaker process is usually near the customer end of the value stream, often the final assembly cell.

11 Source: SUZAKI, Kiyoshi. *Competitividad en Fabricación: Técnicas para la mejora continua "The New Manufacturing Challenge"*. Madrid: Fundación Confemetal, 2010. ISBN-13: 978-84-96612-13-6

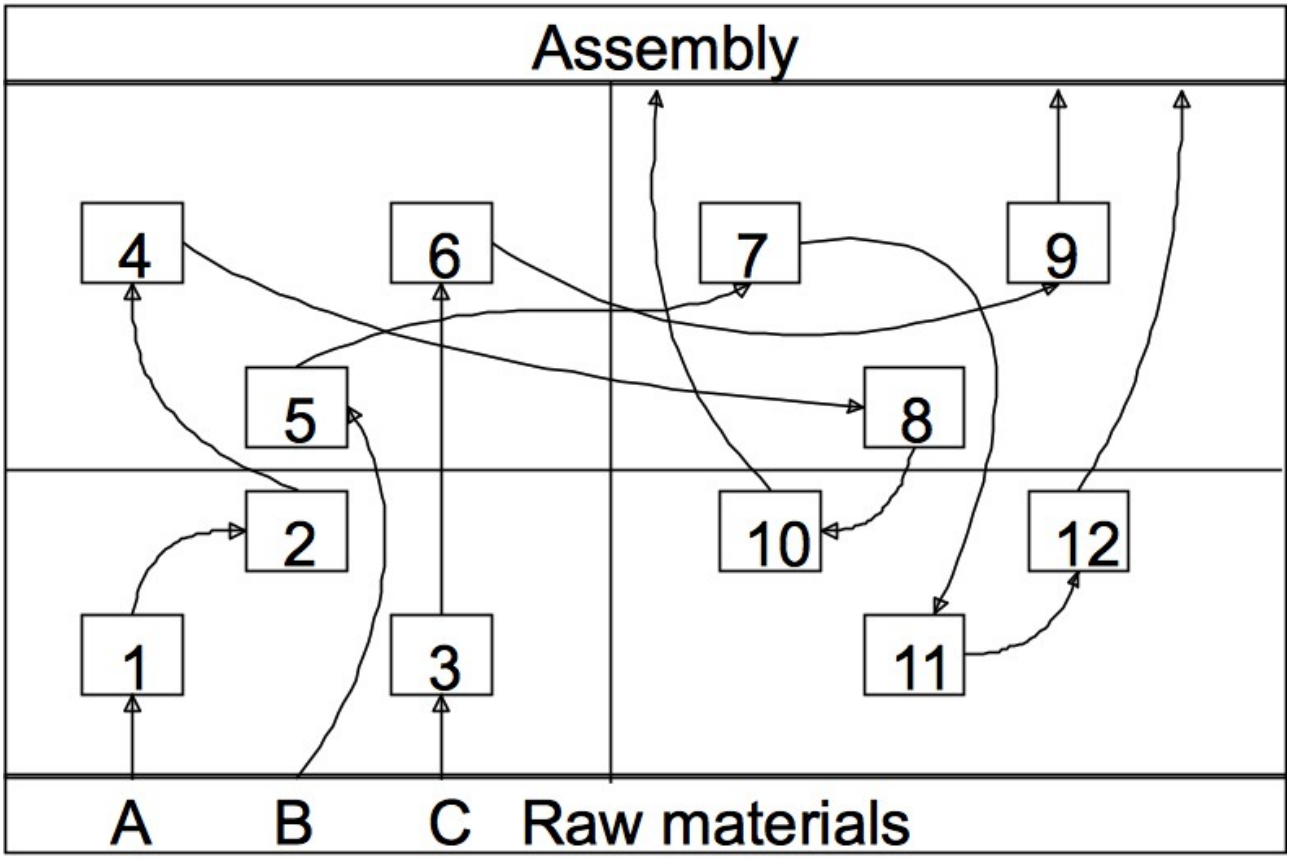

Fig. 4 Process Layout

In this type of layout, workers tend more to their own functional efficiency, prioritizing gross volume that they can produce every day and not the volume required by the next process. Moreover, as consecutive processes can be far one from the other, communication and visibility between people of different departments is worsened.

Product Layout

It is relocating the machines considering the path followed for the product while being manufactured, in order to achieve better use of workers time and that the process flow is continuous, fast and balanced. It will thus be possible to reduce the stock, reduce manufacturing time and detect defects and its cause more easily.

Instead of using an expensive, fast and flexible machine, shared by different families of products, often it is more efficient search or develop cheaper machines, dedicated exclusively to a single line. As the operation of the machines is simplified, operators can be trained to know how to use more than one machine from different processes. If the operators extend their capabilities, will use their time better, coordination between processes will be improved and productivity increased.

The introduction of a Product Layout will also reduce substantially the waste in transportation and double or triple handling of stocks in the process. Moreover, the rapid feedback of information on defects and ease to schedule and prioritize will be very valuable advantages associated with this change.

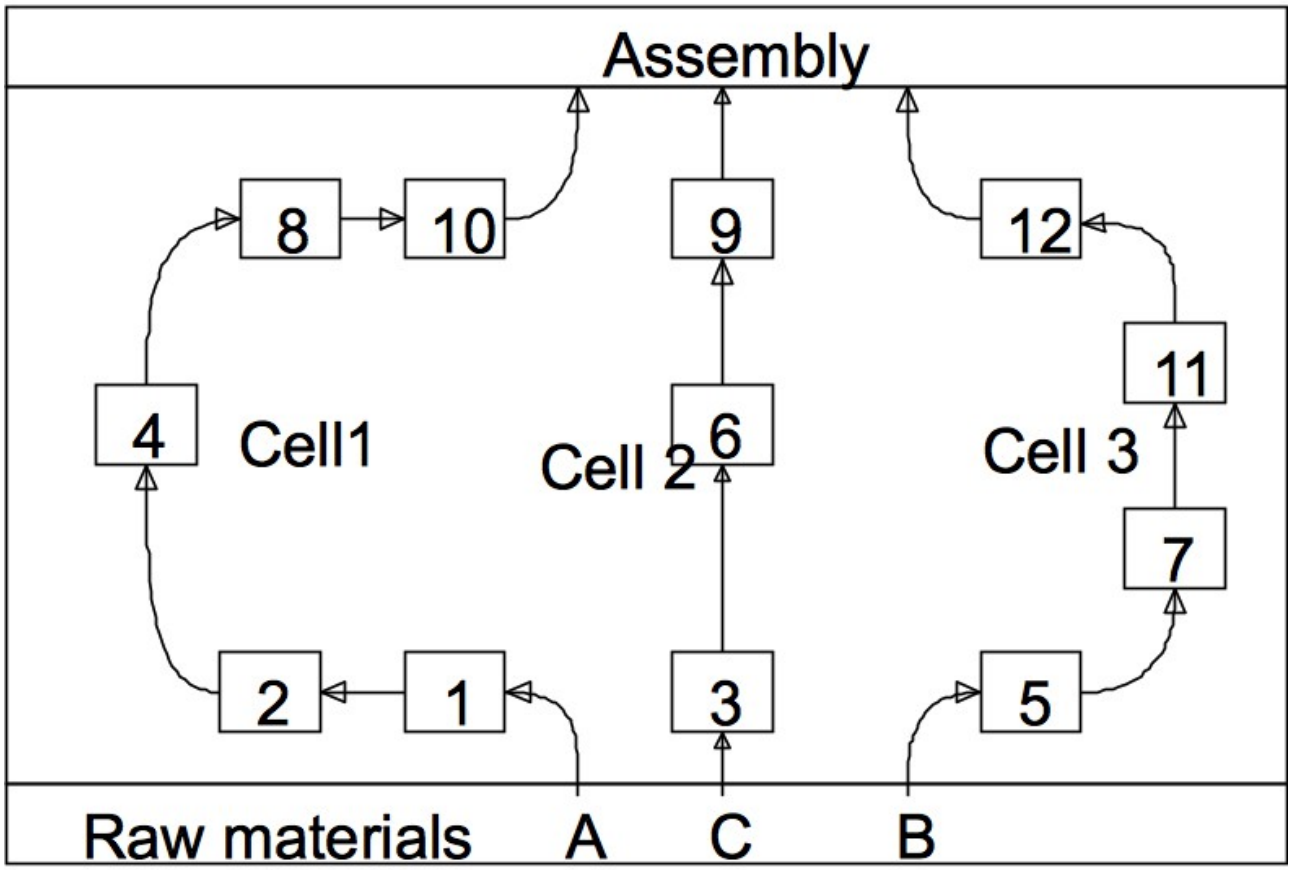

Fig. 5 Product Layout

3.2.3. Cellular Manufacturing[12]

Cellular Manufacturing is a model of workplace design. It is based on some employers, equipment and workstations organized in the order of process flow, to manufacture all or part of a production unit. A cell has the following characteristics:

- It is used one-piece flow or small lots
- Has right-sized and specific equipment for each cell
- It is often designed in C or U shape so the incoming and outgoing goods are easy to be monitored
- The people that works in the cell are trained to be flexible and change workstation if it is necessary

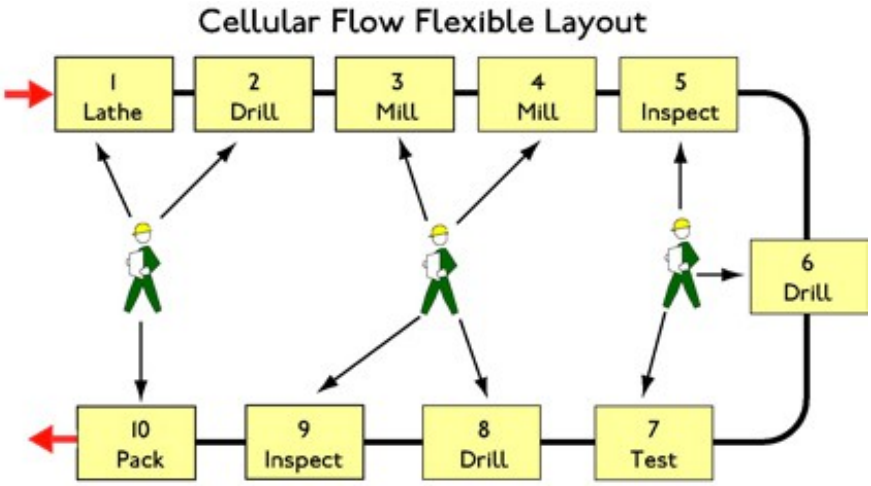

Fig. 6 Cellular Layout

12 Source: WILSON, Lonnie. *How to Implement Lean Manufacturing*. USA: The McGraw-Hill Companies , 2010. ISBN-978-0-07-162508-1

Benefits of cells

The first purpose to a cell is to reduce waste in the system. From the 7 types of waste (transportation, inventory, motion, waiting, over-processing, over-production and defects)[13] cellular production is mainly designed to reduce waste of transportation and inventory. Hence, it achieves a quicker process and reduction of first-piece lead time and lot lead time. So with the reduced lead times, achieved greater flexibility and responsiveness.

Thus, it can be concluded that U shape cells provide three benefits in front of the regular Flow Lines. Firstly, as discussed above, the production rate flexibility possible with cells. Secondly, C or U layout helps communication between workers, because of the proximity to one another. Finally, the fact that the first workstation and the last workstation are near each other makes supervision much easier and gives workers a better sense of work completion.

13 Appendix 1

3.3. Pull System[14]

Pull System is a method used to control the flow of material and information that is replacing only what has been consumed. While a typical company uses production forecasting to determine their work schedule (Push System) can create an excessive amount of inventory or lack of material and add cost to the product, lean company activates their production processes based on customer demand.

The pieces are just placed in a supermarket at the end of each process, which is dimensioned to keep the amount of material sufficient to replace those pieces that are required by the following operation. Signals, called Kanban, authorize the production, movement or material supply according to to customer request.

Fig. 7 Kanban

14 Source: MAS, Xavier. *Introducció al Lean Management*. Barcelona: VILAR RIBA, 2011.

The benefits of Pull System are:

- Short response time
- Increased productivity
- Control and reduction of stocks
- Visual management of production
- Standardization
- Reducing stoppages due to lack components

Supermarket dimension

Supermarket is the place where a product will wait after an operation until being replaced from the next operation. To size the supermarket must take into account the batch size and the frequency of supply and production.

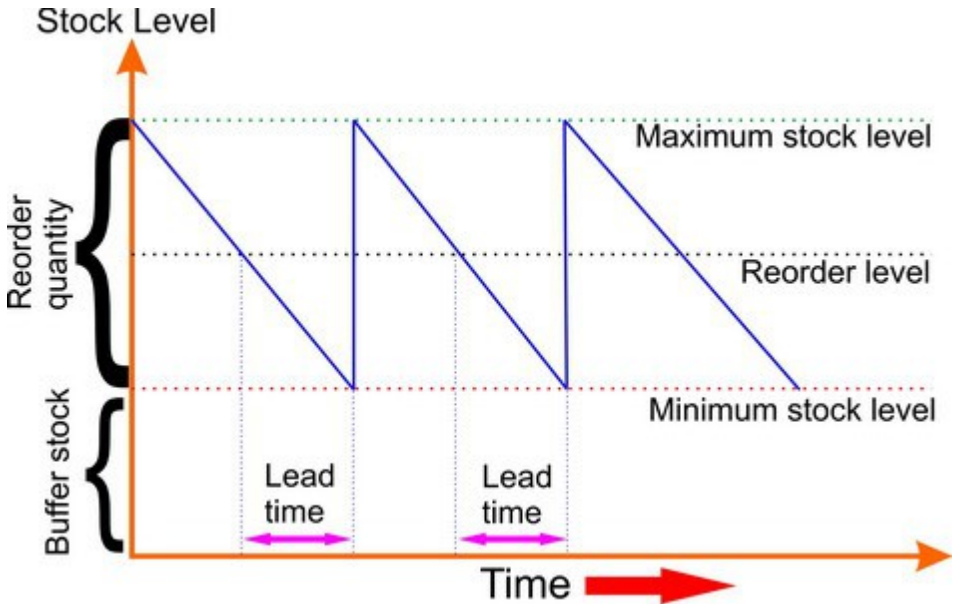

Fig. 8 Stock control

3.3.1. KANBAN[15]

The perfect pull production system, with 100 percent on-time delivery and where once the customer withdrew an item, a signal is sent to replenishment and the system produce another item with all stations synchronized, almost instantaneously, is not possible in the real life. Current processes have variability inside, and this variability creates inventory which, in the same way, causes an increase of the lead time.

Hence, the intention is to reduce the inventory (both raw materials, work in process and finished goods) and still supply the customer with the high levels of on-time delivery. Kanban is able to solve this issue.

Kanban means sign board. Usually it is a card, but it can be many more supports which contain information about the source, destination, part number, and quantity needed of the product. It achieves communicate, in the fastest way possible, how to produce or transport material. It also allows to control the total amount of inventory, as will be seen later.

<table>
<tr><td colspan="4">Part Description</td><td colspan="2">Part Number</td></tr>
<tr><td colspan="4">Smoke-shifter, left handed.</td><td colspan="2">14613</td></tr>
<tr><td>Qty</td><td>20</td><td>Lead Time</td><td>1 week</td><td>Order Date</td><td>9/3</td></tr>
<tr><td>Supplier</td><td colspan="3">Acme Smoke-Shifter, LLC</td><td>Due Date</td><td>9/10</td></tr>
<tr><td rowspan="2">Planner</td><td rowspan="2">John R.</td><td colspan="4">Card 1 of 2</td></tr>
<tr><td colspan="2">Location</td><td colspan="2">Rack 1B3</td></tr>
</table>

Fig. 9 Kanban card sample.

15 Source: WILSON, Lonnie. *How to Implement Lean Manufacturing*. USA: The McGraw-Hill Companies , 2010. ISBN-978-0-07-162508-1

There are two types of Kanban:

- The transportation kanban (authorizes the movement of material)
- The production kanban (authorizes the manufacture)

In both cases, it follows the 6 kanban rules:

1. Later process goes to earlier process and picks up the number of items indicated by the kanban: creates pull, provides pick up or transportation information. The replenishment concept is formed here.

2. Earlier processes produces items in a quantity and sequence indicated by the kanban: provides production information and prevents overproduction.

3. No items are made or transported without a kanban: prevents overproduction and excessive transportation.

4. Always attach a kanban to the goods: serves as a work order.

5. Defective products are not sent to the subsequent process: prevents defective parts from advancing; identifies defective process.

6. Reducing the number of kanban increases their sensitivity: inventory reduction reduces waste and makes the system more sensitive.

Number of kanban

At this point, it can be understood that kanban represents all inventory in the system. To ensure that there is no stockout it is involved the use of three types of finished goods inventory. To assure the normal pick ups by the customers is used cycle stock. It is also necessary carry stocks in order to handle external demand variations and internal supply variations of the finished goods. Therefore, it is used buffer and a safety stock volume, respectively. Hence, the total number of finished goods kanban can be calculated as:

No. of *Kanban* = (Cycle stock + Safety stock + Buffer stock) / Container size

Replenishment time

When a product has been picked up by the costumer, its kanban is transported to Planning, where it is attached with another product, and it restarts de cycle. From Planning it is moved to the queue, while it waits for enter in the production line. Finally, it needs time to deliver the finished good. The sum of all the time spent on transportation and time in these places is called Replenishment time.

3.4. SMED[16]

Single-Minute Exchange of Die (SMED) is a technique that based on the need to produce in Just In Time (JIT), wants to improve the preparation process of a machine in order to reduce the time needed to do it. The goal is that all changeovers and startups should take less than 10 minutes. It is a process of continuous improvement and therefore never ends and can always be improved.

The benefits of this method are:

- Manufacturing in small batches
- React with more flexibility
- Increase productivity
- Reduce delivery time
- Debug preparing machine
- Require less worker skills (simplifying tasks)
- Increase production capacity without investing in new machines
- Increase security
- Reduce stocks
- Having written the method
- Improving the quality

16 Source: MAS, Xavier. *Introducció al Lean Management*. Barcelona: VILAR RIBA, 2011.

To apply SMED it should take the following steps:

1. Preliminary stage: study of the operations of preparing the machine

In this preliminary step, it has to be performed a detailed analysis of the current change process of preparation. To develop this, we must first observe the current conditions of change, using video recording, interviewing workers, analyzing documentation, etc. After that, sign in all actions carried out during the preparation of machine (description of work, spent time, tools and tooling used and other variables to be considered).

2. First Stage: identify and separate internal and external operations

Internal operations are those that must be made with the machine stopped. However, external operations are those that can be performed with the machine running.

3. Secont Stage: converting internal operations to external operations

Observe current operations of internal preparation and find creative solutions to convert them to external preparation operations. For this, it can be used methods or techniques like preparing the operation conditions in advance, standardizing the main functions and using templates.

4. Third Stage: improving operations

Decrease in time of preparation operations. Use techniques to improve internal operations (parallel or simultaneous operations, functional anchoring, elimination of adjustments and mechanization).

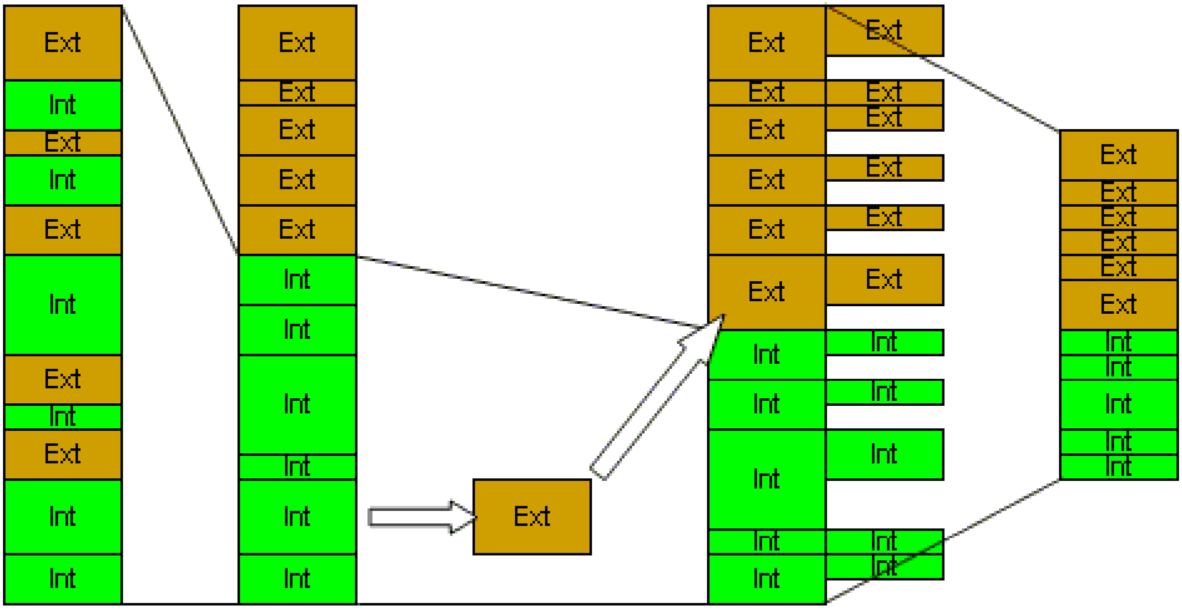

Fig. 10 SMED Summary

3.5. TPM[17]

Total Productive Maintenance (TPM) is a system that involve all employees in the maintenance of the equipment. Everyone have to work to keep it in good working conditions in order to prevent issues and minimize waste. TPM achieves that from the lowest employee to the highest must feel that he/she is responsible to keep the equipment running and, therefore, to prevent any possible breakdown.

Under TPM, operators of the equipment are able to inspect, clean, lubricate, adjust, etc. Hence, it is possible to avoid downtimes for calling a technician. The goals it wanted to get with this are zero breakdowns, maximum productivity and zero defects.

The TPM key strategies are:

1. Focused Improvements (Kaizen)
2. Autonomous Maintenance
3. Planned Maintenance
4. Technical Training
5. Early Equipment Management
6. Quality Maintenance
7. Administrative and Support Functions Management
8. Safety and Environmental Management

17http://www.siliconfareast.com/tpm.htm

And TPM eliminates the following big losses:

1. Breakdowns, which can result in long, expensive repairs
2. Set-ups, conversions, and changeovers
3. Idling and minor stoppages
4. Reduced equipment speed
5. Defects and Rework
6. Start-up Losses

3.6. Jidoka[18]

The concept of jidoka comes from 1900s when Sakichi Toyoda, from Toyota, created a loom that stopped operation automatically when a thread broke. This meant a breakthrough, because while before this each loom were watched by an operator, now the loom was able to run and it just stopped when a mistake occurred.

With the goal of prevent mistakes and thus increase quality, jidoka concept evolved and nowadays it can be seen in most of the companies which apply Lean. The most representative in implementing jidoka are poka-yokes.

3.6.1. Poka-Yoke[19]

The word Poka-Yoke comes from Japanese, from words “yokeru” and “poka” which means “to avoid” and “inadvertent errors”, respectively. Thus, Poka Yoke works prevent mistakes, not catch them when they already occurred.

Poka-Yoke is not a procedure to be followed step by step, but consists of workers think they can do to prevent errors. It is implemented by objects, called poka yoke devices, which stops the machine and alert the workers if something is going to be wrong. Poka yoke devices should be usable by all workers, simple to install, continuous attention from the operator not required, low-cost and instantaneous feedback provided.

18 http://www.lean.org/Common/LexiconTerm.aspx?termid=233

19 http://www.siliconfareast.com/pokayoke.htm

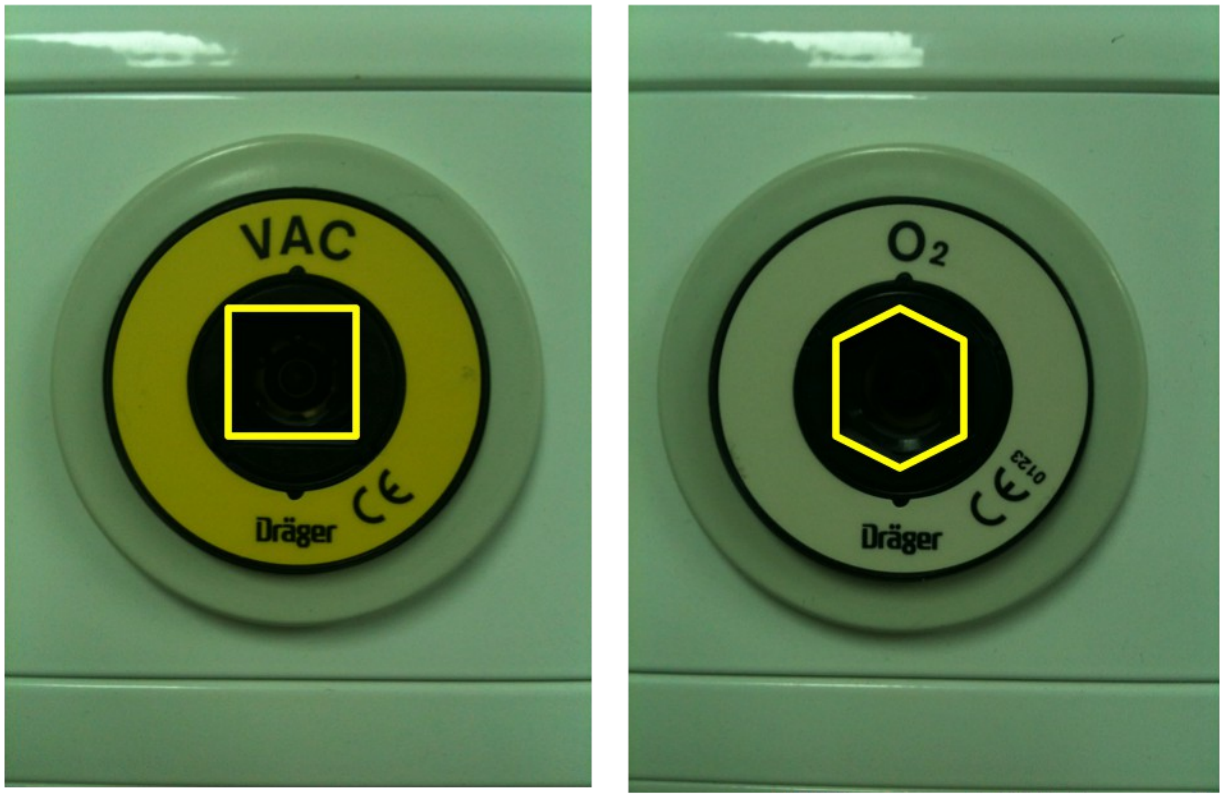

Fig. 11 Exemple of poka yoke device

As it can be seen, poka yoke devices can be anything which achieves of prevent any mistake. As before the mistake detected, better will be the device.

3.7. KAIZEN[20]

The concept Kaizen means 'continuous improvement'. It consists basically to involve everybody in a company to keep improving factory operation. The goal is to create value, eliminate waste, achieve a better environment in the workplace and a stable processes by standardization.

The principles to implement Kaizen are:

- Human resources are the company's most important asset

- Success can not be achieved by some occasional radical changes alone, but more so by incremental yet consistently arriving improvements

- Improvements must be based on a statistical or quantitative study of the performance of the process

Hence, every employee in the company is part of the improving. Therefore, they have to be trained, believe in the idea of Kaizen, be disciplined, get involved and change, if it is required, to contribute to this purpose.

20 http://www.siliconfareast.com/kaizen.htm

EDESA

4 Edesa Horeca

4.1. History

Edesa is a brand in Fagor Industrial Group which, at the same time, is part of Montragon Corporation. Mondragon is a cooperative organization which was founded in 1956, when it was created the first industrial cooperative in Donostia (Basque Country).

The brands that constitute Fagor Industrial Group are: Fagor, Edesa, Asber, Laundry Div (Danube, Domus, Primer and Fagor) and Efficold.

Fig. 12 Fagor Industrial Group brands

Edesa opened a production plant near Warsaw (Poland) in 2004 to supply the demand from Poland and Occidental Europe.

4.2. Current situation

Edesa belongs to Fagor Industrial Group, which has global presence with 9 productive plants around the world: Spain (Onati, Lucena, Inoxfera, Vic), France, Poland, Turkey, China and Mexico and more than 20 commercial offices World wide.

Edesa Horeca is an industrial company specialized in devices manufacture in HORECA sector (hotel industry, restoration and catering), developing its activity in Poland and Occidental Europe. Its productive plant is located in Czosnow, 20km far from Warsaw, and consists of 8000m^2, 4000m^2 for manufacturing and 4000m^2 for finished good stock. Its invoicing in 2012 was 35 millions zl and its growth plans are 48 millions for 2013, 60 millions for 2014 and 80 millions for 2015, framed in a strategic plan for growth and increased profitability.

Like many multinationals, Edesa Horeca has a matrix structure in order to exploit the synergy of the group, purchasing volume, product standardization, share resources, etc. Therefore, areas such as finance, sales, design or commercial follow a strategy largely based on a common corporate model.

Nowadays, companies have to work with:

- Financial and economic crisis affecting the disposition of cash and financing activities, and also the purchasing power of end consumers

- Fluctuating demands, causing large uncertainty

- A very fierce global competition that results in a cost structure very pronounced

Is when Lean Management fits perfectly with the strategic plan based on search of profitability, growth, improve competitiveness and efficiency and customers satisfaction, forcing the company to be much more flexible and dynamic to adapt products and services to the new reality.

4.3. Organizational structure

Edesa Horeca production plant in Czosnow is composed of 5 departments which work together:

- Sales
- Finance
- Purchasing
- Manufacturing
- Design

It also can be distinguished three family products:

- Neutral: countertops, shelves, cabinets
- Cooling: refrigerators, freezers
- Cooking: ovens, stoves

Fig. 13 Neutral

Fig. 14 Cooling

Fig. 15 Cooking

5 Lean in Edesa Horeca

The 3 Lean pillars in Edesa Horeca are:

1. Continuous Improvement: A committee of efficiency works on the search of the optimization and the processes excellence.

2. Quality Control: Quality is a problem on everything. In Edesa Horeca, this is handled by the sales department.

3. Just in Time: Reduce delivery time.

Lean implementation in Edesa Horeca

The future plans of Edesa Horeca are to apply Lean using all its techniques. Currently, Edesa Horeca just has developed 5S's, Heijunka, KAIZEN and is starting to study the KANBAN application in production processes. Other techniques as SMED, TPM or Jidoka are not sufficiently developed yet.

5.1. 5S's

Edesa Horeca has applied some actions with the aim of improving tidiness, orderliness, cleanliness, standardization and discipline in the workplace. These actions are listed in the following table, with the date of application, the responsible of it and with a description:

Table 1 5S's actions

IMPLEMENTATION 5S's in EDESA HORECA				
	ACTION	**DATE**	**RESPONSIBLE**	**DESCRIPTION/PICTURE**
		SEIRI		
1)	Removed obsolete machines	FEB-2013	PRODUCTION MAINANTANCE	Remove those machines that become useless because of the processes have been changed.
2)	Removed obsoletes components and materials	JUN-2013	PURCHASE PRODUCTION	Remove those pieces or materials that won't be useful any more because the product has been changed.
3)	Removed components and materials down rotation	JUL-2013	PURCHASE PRODUCTION	Some components or materials are just used once a year or less. Because of this down rotation, sometimes they become useless or they should be located not with the components that are often used in the process.
5)	New location for Cooking manufacturing	FEB-2013	PRODUCTION MAINANTANCE	After analyzing the production flow, it has been considered that one of the most distortionary elements was to keep the Cooking manufacturing area in the Neutral manufacturing line. For this reason, it has been decided to look for a new location for the Cooking manufacturing area.

Table 1 5S's actions

SEITON				
1)	Marked step corridors	JAN-2013	PRODUCTION	 Black and yellow stripes tapes are used to mark the corridors.
2)	Marked work areas	FEB-2013	PRODUCTION	As the same way as corridors, work areas have been marked.
3)	Created working Cellular manufacturing boxes (welders, polishers, assembly, packaging)	NOV-2013	PRODUCTION	Few separated boxes with its own equipment have been created for welders, polishers, assembly, packaging.

Table 1 5S's actions

4)	Defined stock levels	JUNE 2013	PURCHASE PRODUCTION	The stock levels have been limited in order to not have more stock than required by customers demand and the safety stock.
5)	Stock products organized by family	MAY-2013	PURCHASE	 To achieve a quicker found of any stock product, they are reorganized by families.

Table 1 5S's actions

6)	Put tanks for parts	MAY-2013	PURCHASE	 Parts used for assembly are kept in tanks, easily identifiable.
SEISO				
1)	Integrating the cleaning in the operator activity	FEB-2013	PRODUCTION	The workplace has to be cleaned after each shift.
SEIKETSU				
1)	Processes have been standardized	JUL-2013	PRODUCTION	Every procedure in each process have steps to be followed established in advance.

Table 1 5S's actions

2)	Safety in the workplace has been standardized	JAN-2013	PRODUCTION	
SHITSUKE				
1)	Audits by the Plant Manager	JAN-2013	PRODUCTION	Plant Manager makes audits every certain time periods in order to ensure that everything is running right.

5.2. Heijunka

Implementation in Neutral Line.

Given the large fluctuations in demand, it is necessary to adapt production to customer needs. The demands of customers in terms of delivery times, working increasingly with customized product, working for projects instead of standards and research in diversification in customers and products to reduce the risk, cause a lot of manufacturing orders. In this context, Edesa Horeca decides to search a stable and leveled production system through small batches manufacturing, fast changes and especially intensify the level of flexibility in the company.

It is important to say that Edesa Horeca decided to start to implement Lean Manufacturing in the *neutral line process* due to the opportunities, chances that its Group and market was offering at this moment.

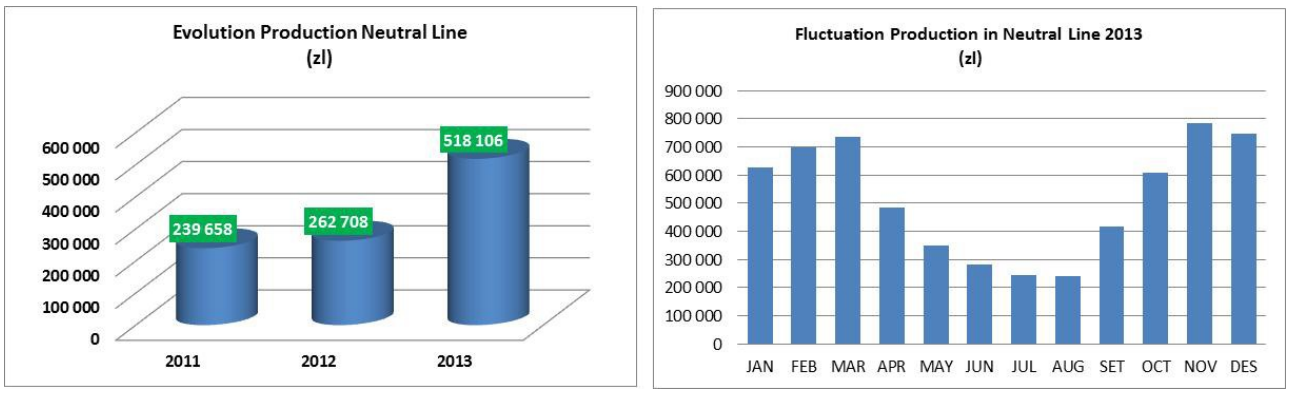

Fig. 16 Evolution Production Neutral Line

The Neutral Business Line consists on manufacturing products for the field of the distribution and preparation foodservice equipment, committed to creating and providing unique solutions with innovative, customized, durable and efficient products. Generally speaking, it is very similar to the activity of the furniture field but specialized for Food Distribution and Preparation.

Fig. 17 Neutral Business Line

Being their strong skills:

1. Food Distribution and Preparation Specialist.
2. Flexible and Customized Solutions
3. Global Manufacturing Brand
4. Quality and Environmental Sustainability.

To be a specialist means to be focused on innovation. This belief motivates them to continuously research, develop and create new answers to solve the toughest challenges in the distribution and preparation of food.

Their efforts are directed to the development of practical, customer-oriented solutions intended to:

- Boost taste and visual appeal of food on display.
- Decrease food processing and serving time.
- Increase efficiency of food preparation and distribution.
- Reduce energy consumption.
- Minimize labor costs.
- Improve safety conditions.
- While maintaining the consistency and quality of food.

For all these reasons, Edesa Horeca has based the implementation of Heijunka on improving on the following points:

5.2.1. VSM (Value Stream Map): Neutral Line

Neutral Process Description:

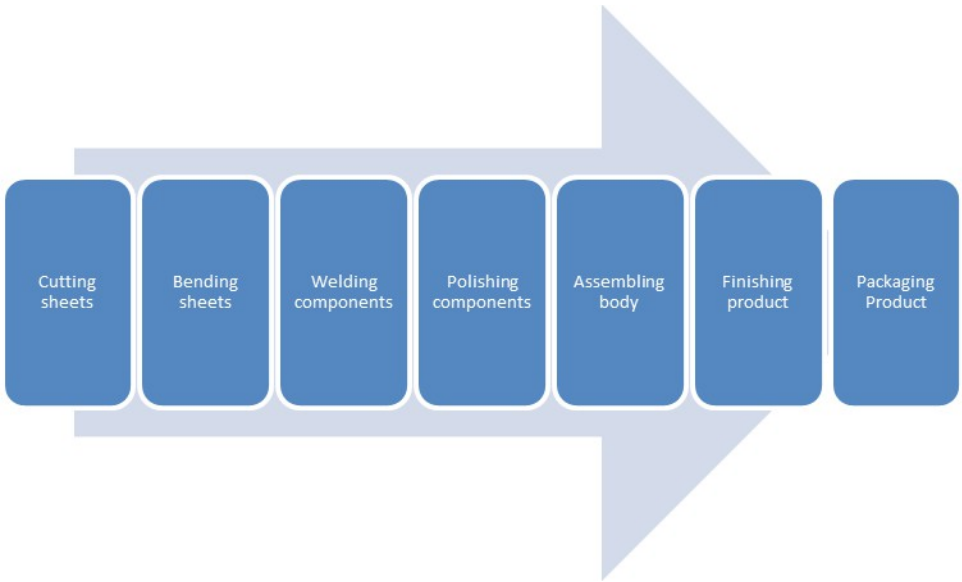

Fig. 18 Neutral production process

Before implementing lean manufacturing process and after the initial training, in order to find these improvements, it has been formulated a questionnaire, with the name *LEAN IMPLEMENTATION QUESTIONNAIRE IN EDESA HORECA*, to analyze which opportunities should be taken according to the following steps:

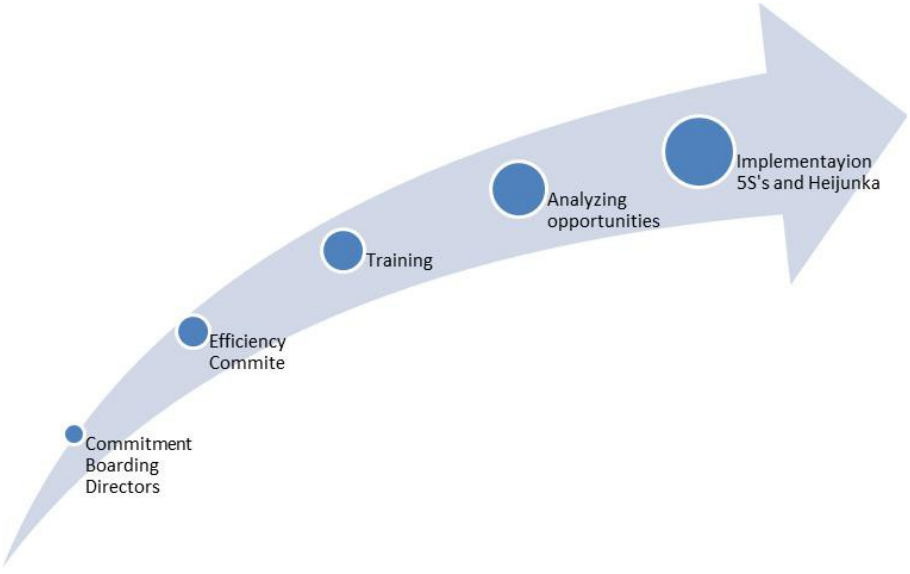

Fig. 19 Steps to implement 5S's and Heijunka

- Commitment Boarding Directors: Design general targets, goals, qualitative objectives to be reached according to the strategy of the company and the group.

- Efficiency Committee: Design specific targets, goals, quantitative objectives according to the agreements gotten by Boarding Directors.

- Training Lean thinking: Teach the concept of Lean thinking to all employees involved in the project, according to the different levels:

- **Level 1:** Boarding Directors
- **Level 2:** Responsible of functional area
- **Level 3:** Operators

- Analyzing opportunities: The efficiency committee starts to analyze which areas could be improved according to Lean thinking philosophy and the strategy of the company and the group. For this reason, it is created a procedure as questionnaire to know which potential areas will be chosen to implement some Lean techniques such us Heijunka, 5S's, etc. This questionnaire is detailed in the following table, called *Lean Implementation Questionnaire,* and it was focused on the neutral line.

- Implementation of lean techniques 5S's and Heijunka: According to the strategy of the company, Edesa Horeca started analyzing and implementing Lean manufacturing in the business line, called neutral, because of the potential opportunities caused by the markets situation.

LEAN IMPLEMENTATION QUESTIONNAIRE IN EDESA HORECA HEIJUNKA: Implementation in Neutral Line Production		
	Question	**Answer**
01	Where a continuous flow can be created in the production process, avoiding having stoppages between operations?	We could create a continuous flow in the production process of assembly of neutral products.
02	What operations can be integrated or reduced?	Polishing, welding, assembling, finishing and packaging.
03	What is the lead time and therefore the reaction time to customer?	3-4 weeks.
04	Where the stock is located and in what quantities?	The stock is located in several points of the plant and warehouse depending on the type of every component (raw material, auxiliary components). It is created an area specific for them. The quantities of them depending of the security stock.
05	Are the stock levels clearly marked and defined?	The stock levels are **NOT** clearly marked and defined.
06	Are the batches of production constant?	The batches of production are **NOT** constant.
07	Which transports or displacements are real needed?	The transport of raw material to the punching machine and cutting lines. The transport of the finished products to the warehouse.
08	Are the displacements to access tools required?	The displacements to access to the tools are **NOT** required.
09	The components or materials are easy to catch?	The components or materials are **NOT** easy to catch due to size of them.

10	Where the rejected pieces are located and in what quantities?	The rejected pieces are located in containers without limit for it.
11	Can operators stop the line if a problem is detected?	**Yes,** they can stop the line.
12	How long does it take to make a change in the production?	Between 1 hour and 3 hours.
13	Are machines, equipment and facilities dirty?	The machines are **NOT** dirty.
14	It can be considered that there is a lack of organization on the layout?	**Yes**, we can considerate that we must improve the organization.
15	Is there a production program at every work point?	**Yes**, we have a scheduling plan for every process.
16	Are all products identified by card?	**Not** all the products are identified.
17	Is there a continuous flow of materials?	We do **NOT** have a continuous flow of materials. We have a lot of special and customized products.
18	Do workers make mistakes in operations?	**Yes**, the operators can make some mistakes.
19	Are applied prevention of errors methods?	They are **not** applied.
20	Do complaints appear after a certain process?	**Yes**, the complains appear after process.
21	Do workers know the machines (adjustments set up)?	**Yes**, they know the machines.
22	Is anyone able to explain when things are normal?	**Not**, only the team leaders and responsible of plant are able to explain when the “process is normal”.
23	Do useless elements exist in production plant?	**Yes**, exists some not useful elements.

24	Do constant breakdowns occur in machines? Are monitored or registered?	**Yes** we have breakdowns .They are **not** registered.
25	Can be said that there is a place for everything and something for every place?	We can**not** say that.
26	What is the degree of versatility staff	**Very down**. They are specialists in their tasks and it is difficult to be flexible.
27	How are the relations with suppliers?	They are not good. The relations with the suppliers are stressful and we have sometimes conflicts because of stock outs due to fluctuation of demand and delivery time and quality problems.
28	Is exploited the ability of workers to suggest improvements?	**Not.**
29	Is there a standardization of the process?	**Not.**
30	Is it provided visual work indicators and are they easy to understand?	**Not.**

Table 2 Lean implementation questionnaire in Edesa Horeca

5.2.2. Work Flow Process: layout

From the initial situation (layout before Lean implantation) it has been designed a future layout without waste or the least possible. On this future layout it can also be seen a continuous flow, during all activities, and stock levels (finished goods, work in process and raw materials) will be minimal.

After analyzing the process and because it seeks to increase the number of products in neutral production line and, therefore, its productive capacity, it becomes a priority to start implementing Lean in this area according with the growth strategy and opportunities offered by the sector.

The main requirement in the strategic plan is avoid large investments in production facilities, being basic space optimization.

CURRENT SITUATION :

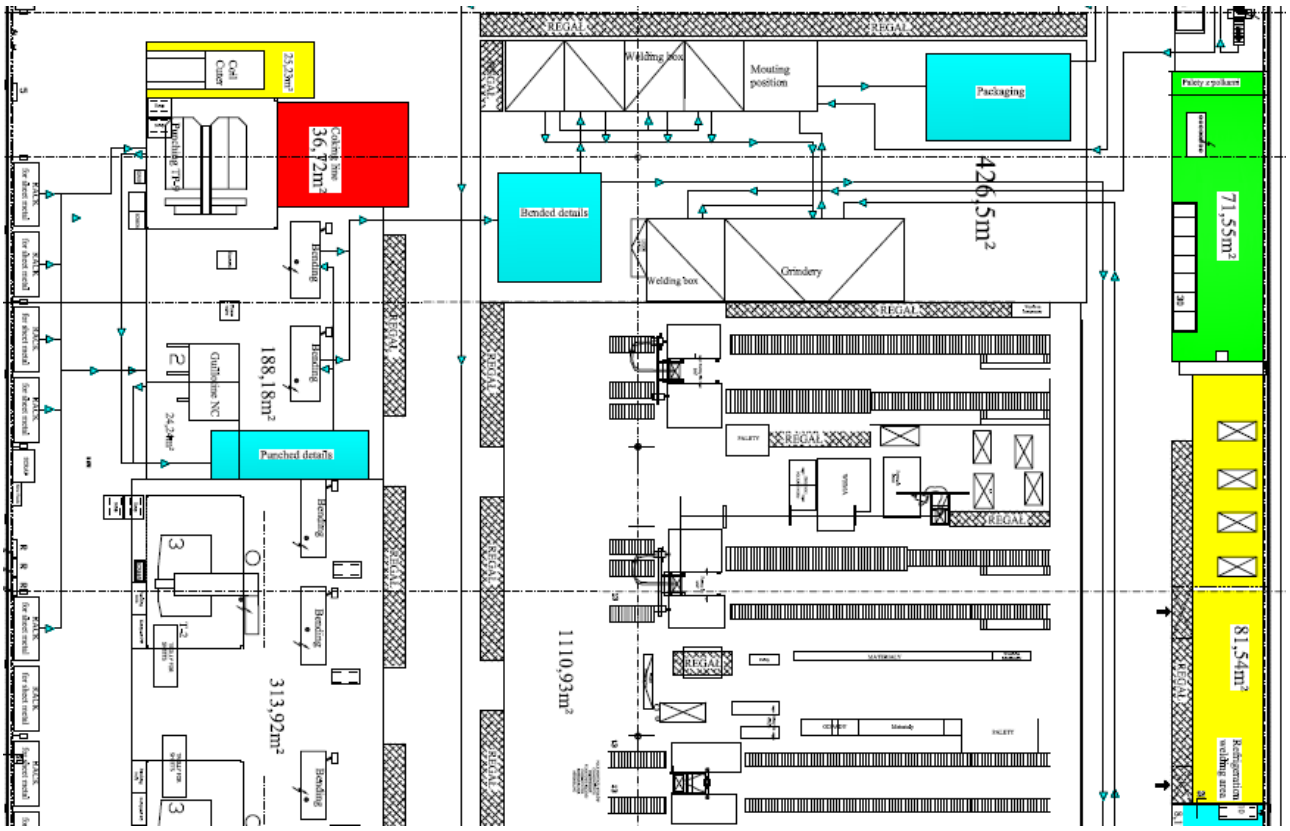

Fig. 20 Neutral production line layout and flow material map

Main process flow		Distance
Sheet metal details	Punching (8m+24m), bending (6m+16m)+welding (6m+9m) + grinding (6m) + Montage (6m) ++ grinding (6m) + Montage (6m)+Packaging (12m)	105m
Sheet metal details+Fusing tops	Punching (8m+24m), bending (6m+16m)+welding (6m+9m) + grinding (6m) + Montage (6m) ++ grinding (6m)+ Fusing tops (124m) + Montage (6m)+Packaging (12m)	229m
Profiles details	Cutting profiles (1m) + grinding profile (6m) + welding (40m) + grinding (12m) + montage (6m)	64m
Purchasing details	Transport purchased details from magazine to montage	64m
Finished details	Transport finished details from packaging to magazine	100m

Fig. 21 Main process flow with distances

Actions to be implemented will be taken in 2 steps:

Step A

1. Move cooking line (red area) to other specific area for this activity.
2. Move refrigeration Press 1 in order to increase the space in neutral area.
3. Set up a second line for neutral production.

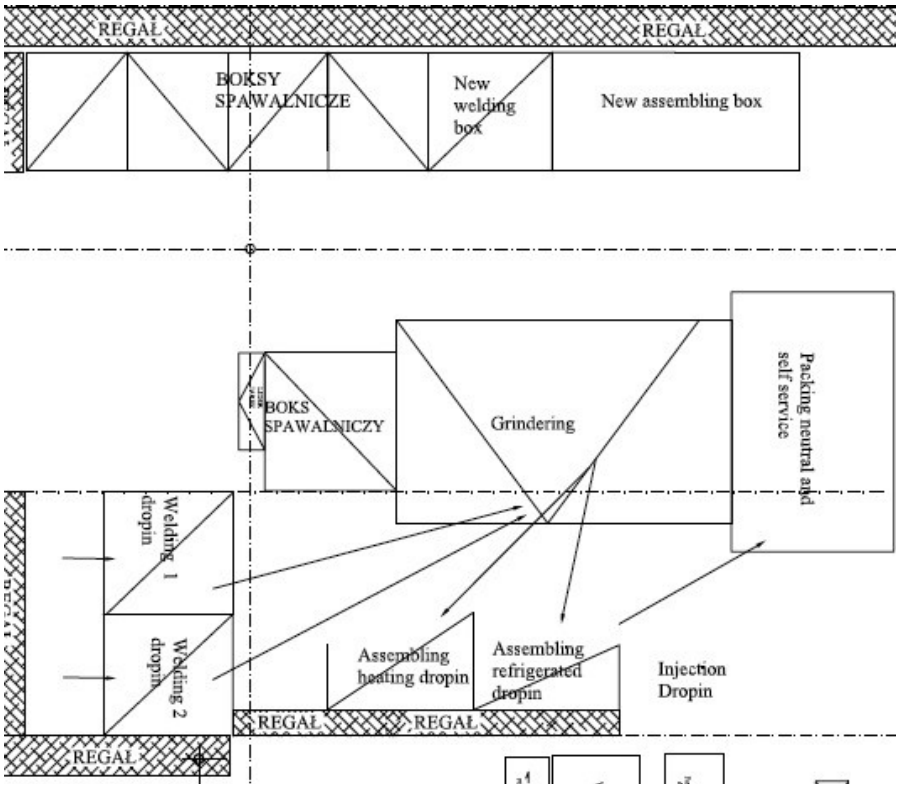

Fig. 22 Layout Neutral Line for step 1

Cellular Manufacturing (Step B)

It was analyzed and studied the process in the neutral line and it can be confirmed that could exist different families of products which have a common work flow process of materials and activities.

Fig. 23 Neutral product families

For this reason we are thinking to create a small cellular manufacturing for every product in order to eliminate unnecessary movements and reduce stocks.

5.3. Pull System

Edesa Horeca is looking for a system which can satisfy the needs of the clients across a process based in a high quality and reliable production in short times for every process. For this reason, it needs to implement a pull production system with continuous working flow and with small batches. This system could be the KANBAN system.

5.3.1. KANBAN

The objectives that Edesa Horeca wants to achieve with KANBAN implementation are:

1. Simplify the administrative tasks of production management and launching orders to suppliers.

2. Regulate and reduce the level of stocks achieving that every operator only makes the quantity done in the previous process.

3. Potentiate and stimulate the improve of methods and reduce stocks focusing on the causal problems (neck bottles, defects, repairs,..) being possible to be solved.

4. Implement a visual control system that helps to find the problems in production.

5. Facilitate the continuous flow of production and keep it balanced during the process.

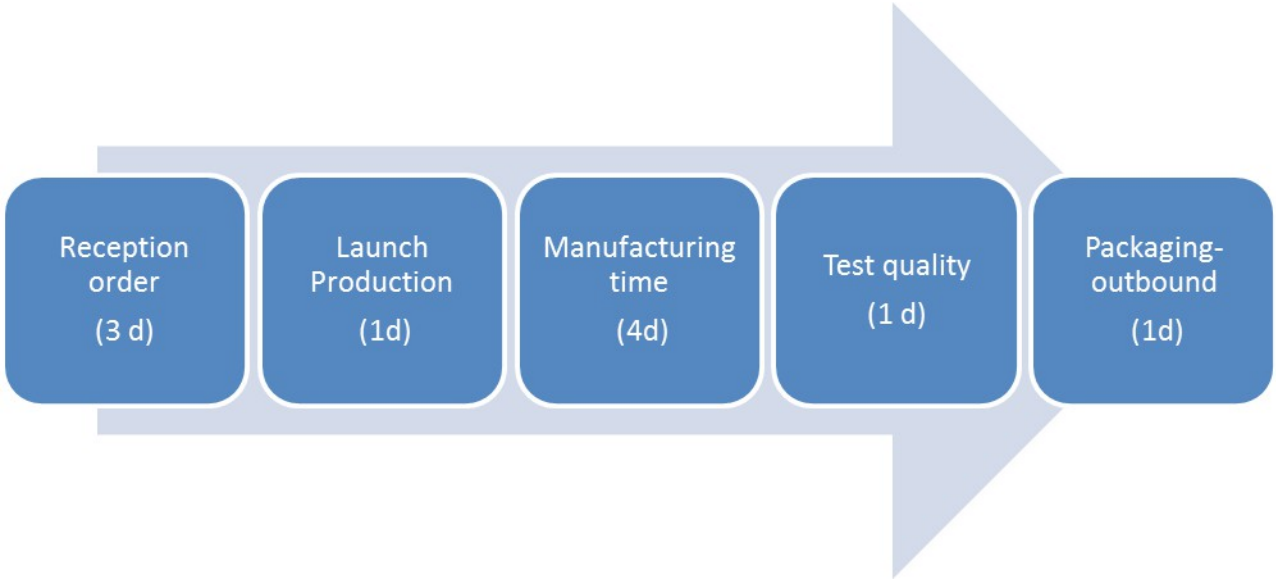

Fig. 24 Production process (duration of each operation in days)

KANBAN will be applied in Edesa Horeca provably next year, when its study has been finished and the trial period has been successful.

5.4. SMED

Edesa Horeca has not applied any SMED operation yet. The main reason is that they have other priorities, like the increase of Neutral production area, improve the flow layout or apply 5S's, before this. Anyway, once other priorities solve it, it could be good to make a SMED study on some machines in the company and thus continue improving, reducing delivery times.

5.5. TPM

Total Productive Maintenance (TPM) has not been applied. The reason is that Edesa not have a highly developed technology to invest in its application. Another reason is also that the current priorities are others. Nonetheless, as in the previous case, focusing on the Total Productive Maintenance would achieve avoid future issues in production processes.

5.6. Jidoka

Jidoka is the least developed measure in Edesa Horeca. It is not been thought or planned to do anything by the moment. Even so, would result very interesting to think in original and simply things that could help to prevent future mistakes. Poka-yoke devices are one of this measures that could achieve this purpose.

5.7. KAIZEN

It has been created a committee where the following members are involved:

- Plant Manager
- Purchasing Manager
- Procurement Manager
- Design Technician
- Manufacturing Team Leader
- Maintenance

This committee meets, every Friday at 10am, to track the evolution with this implementation and add improvements. They use a system of measurement and control explained below.

Implementing a system of measurement and control

In a control panel, the results are measured and compared with the previously stated objectives and with the results of previous years.

Operational objectives:

- Improve employee-sales rate
- Improve zl-m² rate
- ml per piece
- WIP reduction: working in process
- Rate of rejection
- Reduce “Merma” (raw material losses)
- Delivery time
- Lead Time

Financial objectives

- Improve rotation stocks of finished products
- Improve rotation stocks of component and raw materials
- Increase in available cash
- Improve industrial margins
- Improve economic viability

Training Program in Lean Philosophy

It is really important to train the employees in Lean Philosophy aiming to achieve the best results with Lean implementation. Hence, it will be necessary:

- Introduction of the team leader figure.
- Training in functional areas: Sales, Design, Manufacturing, Maintenance, Quality, Team Leaders

6 CONCLUSIONS

It has been seen that Edesa Horeca has already applied some Lean techniques, KANBAN is currently being established and other techniques are planned to implant in the future. The following table summarizes the current state and forecast of Lean techniques in the company:

	Well established	Being established	Planned to establish	Not plan to establish
5S's	X			
Heijunka	X			
Pull System: KABAN		X		
SMED			X	
TPM			X	
Jidoka			X	
KAIZEN	X			

Table 3 Current state and forecast for Lean techniques

The 5S's actions applied until now have been well received in the company and have noticed improvement in the workplace. Moreover it will help to implant new actions related to Seiri, Seiton, Seiso, Seiketsu or Shitsuke.

Heijunka benefits in Edesa Horeca have been reflected clearly in the increase of productivity and thus the increase of money earn since it was established at Neutral Production Line. To apply Heijunka it needs to invest more time and resources than other Lean techniques, but then it normally achieves more notable benefits.

KANBAN implementation is currently being studied. With it is wanted to achieve increase in productivity, stocks reduction, visual management of production, standardize and stoppages reduction.

SMED, TPM and Jidoka have not been applied yet. However, it is planned to establish this techniques when other priorities, that currently Edesa Horeca has, have been solved.

Continuous improvement, Kaizen, is a key point in Lean implementation. Therefore, the committee created to measure and control the production activity has been essential to achieve significant improvements as waste reduction or improvement in delivery time. It has also helped to introduce employees to Lean Philosophy.

To summarize, it can be concluded that Lean implementation in an organization will achieve significant improvements in profitability, optimization and efficiency. However, it will need long periods of time to adapt and a good way to do it is ordering techniques to implement in function of priorities of the organization.

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Appendix 1

Waste (Muda)

Waste is anything that does not add value or transformation to the product, anything that interrupts its flow. Waste adds unnecessary time and costs to the process and makes it less competitive. We can distinguish seven kinds of waste:

- Transportation

Because of transportation does not make any transformation to the product, materials movement must be reduced as much as possible.

- Inventory

The goods which are in stock are not adding value to the product. Excess stock also hinders the flow.

- Motion

Unnecessary or uncomfortable movements can increase the processing time. Cluttered work areas, unidentified locations or working method not optimized are few of these causes.

- Waiting

Unbalanced workloads, unplanned downtime, changes in long preparation or quality problems in previous processes may cause workers waiting unnecessarily somewhere during the process.

- Over-processing

It must be known what the client require and detect the operations which do not add value in order to eliminate them.

- Over-production

To not become waste, it has to be exactly produced what customer needs, when customer needs and the quantity customer needs.

- Defects

Defects must be analyzed to its root cause to obtain a final solution.

Appendix 2

Lean Enterprise Institute

Capsule Summaries of Key Lean Concepts

Source: *Lean Lexicon*.

Continuous Flow
Producing and moving one item at a time (or a small and consistent batch of items) through a series of processing steps as continuously as possible, with each step making just what is requested by the next step. It is also called one-piece flow, single-piece flow, and make one, move one.

Cycle Time
How often a part or product is completed by a process, as timed by observation. This time includes operating time plus the time required to prepare, load, and unload. The appropriate calculation of cycle time may depend upon context. For example, if a paint process completes a batch of 22 parts every five minutes, the cycle time for the batch is five minutes. However, the cycle time for an individual part is 13.6 seconds (5 minutes x 60 seconds = 300 seconds, divided by 22 parts = 13.6 seconds).

Jidoka
Providing machines and operators the ability to detect when an abnormal condition has occurred and immediately stop work. This enables operations to build-in quality at each process and to separate men and machines for more efficient work. Jidoka is one of the two pillars of the Toyota Production System along with just-in-time. Jidoka is sometimes called autonomation, meaning automation with human intelligence.

Just-in-Time (JIT) Production
A system of production that makes and delivers just what is needed, just when it is needed, and just in the amount needed. JIT and jidoka are the two pillars of the Toyota Production System.

Kaizen
Continuous improvement of an entire value stream or an individual process to create more value with less waste. There are two levels of kaizen: (1) System or flow kaizen focuses on the overall value stream and (2) process kaizen focuses on individual processes.

Kanban
A signaling device that gives authorization and instructions for the production or withdrawal (conveyance) of items in a pull system. The term is Japanese for sign or signboard.

Lean Production
A business system for organizing and managing product development, operations, suppliers, and customer relations that requires less human effort, less space, less capital, and less time to make products with fewer defects to precise customer desires, compared with the previous system of mass production.

Lean production was pioneered by Toyota after World War II and, as of 1990, typically required half the human effort, half the manufacturing space and capital investment for a given amount of capacity, and a fraction of the development and lead time of mass production systems, while making products in wider variety at lower volumes with many fewer defects. The term was coined by John Krafcik, a research assistant at MIT with the International Motor Vehicle Program in the late 1980s.

Lean Thinking
A 5-step thought process proposed by James Womack and Dan Jones in their 1996 book *Lean Thinking* to guide managers through a lean transformation. The steps are:

1. Specify value from the standpoint of the end customer.
2. Identify all the steps in the value stream.
3. Make the value creating steps flow toward the customer.
4. Let customers pull value from the next upstream activity.
5. Pursue perfection.

Obeya
Obeya in Japanese means simply "big room." At Toyota it has become a major project management tool, used especially in product development, to enhance effective and timely communication. Similar in concept to traditional "war rooms," an Obeya will contain highly visual charts and graphs depicting program timing, milestones and progress to date and countermeasures to existing timing or technical problems. Project leaders will have desks in the Obeya as will others at appropriate points in the program timing. The purpose is to ensure project success and shorten the plan-do-check-act cycle.

Pacemaker Process
Any process along a value stream that sets the pace for the entire stream. (The pacemaker process should not be confused with a bottleneck process which necessarily constrains downstream processes due to a lack of capacity.) The pacemaker process is usually near the customer end of the value stream, often the final assembly cell.

Plan, Do, Check, Act (PDCA)
An improvement cycle based on the scientific method of proposing a change in a process, implementing the change, measuring the results, and taking appropriate action. It is also known as the *Deming Cycle* after W. Edwards Deming who introduced the concept in Japan in the 1950s. The PDCA cycle has four stages:

1. Plan: Determine goals for a process and needed changes to achieve them.
2. Do: Implement the changes.
3. Check: Evaluate the results in terms of performance.
4. Act: Standardize and stabilize the change or begin the cycle again, depending on the results.

Production Lead Time (also **Throughput Time** and **Total Product**

Cycle Time)
The time required for a product to move all the way through a process from start to finish. At the plant level this is often termed door-to-door time. The concept can also be applied to the time required for a design to progress from start to finish in product development or for a product to proceed from raw materials all the way to the customer.

Takt Time
The available production time divided by customer demand. For example, if a widget factory operates 480 minutes per day and customers demand 240 widgets per day, takt time is two minutes. Similarly, if customers want two new products per month, takt time is two weeks. The purpose of takt time is to precisely match production with demand. It provides the heartbeat of a lean production system. Takt time was first used as a production management tool in the German aircraft industry in the 1930s. (Takt is German for a precise interval of time such as a musical meter.) It was the interval at which aircraft were moved ahead to the next production station. The concept was widely utilized within Toyota in the 1950s and was in widespread use throughout the Toyota supply base by the late 1960s. Toyota typically reviews the takt time for a process every month, with a tweaking review every ten days.

Toyota Production System (TPS)
The production system developed by Toyota Motor Corporation to provide best quality, lowest cost, and shortest lead time through the elimination of waste. TPS is comprised of two pillars, just-in-time production and jidoka. TPS is maintained and improved through iterations of standardized work and kaizen, following the scientific method of the plan-do-check-act cycle.

Development of TPS is credited to Taiichi Ohno, Toyota's chief of production in the post-WWII period. Widespread recognition of TPS as the model production system grew rapidly with the publication in 1990 of *The Machine That Changed the World*, the result of 5 years of research led by the Massachusetts Institute of Technology. The MIT researchers found that TPS was so much more effective and efficient than traditional, mass production that it represented a completely new paradigm.

Value Stream
All of the actions, both value-creating and nonvalue-creating, required to bring a product from concept to launch and from order to delivery. These include actions to process information from the customer and actions to transform the product on its way to the customer.

Value Stream Mapping (VSM)
A simple diagram of every step involved in the material and information flows needed to bring a product from order to delivery. A current-state map follows a product's path from order to delivery to determine the current conditions. A future-state map shows the opportunities for improvement identified in the current-state map to achieve a higher level of performance at some future point.

Waste
Any activity that consumes resources but creates no value for the customer.

NOTE: Members of the media should contact Chet Marchwinski, LEI

communications director, at (203) 778-0670 or cmarchwinski@lean.org for a complete copy of the *Lean Lexicon*, which contains illustrations and more in-depth definitions.